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# ALMOST ALLUVIAL CHANNEL DESIGN

Realigning a partially-confined, semi-alluvial shale bedrock channel

Roger TJ Phillips, P.Geo. and Emma Buckrell, E.I.T.

Aquafor Beech Limited

OAKVILLE

# Alluvial channel design and NCD – what's the difference?

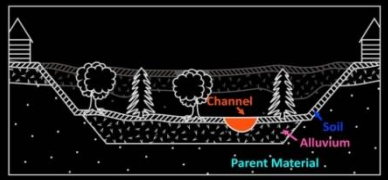
? ← Natural Channel Design → ?

Dynamics **STREAM RESTORATION CONTINUUM** Control

(Threshold Sediment Mobility) **THRESHOLD STABILITY** →

| Alluvial Dynamic | Alluvial Semi-Stable | Soft Hybrid | Hard Hybrid | Fixed Engineered |
|---|---|---|---|---|

# Dynamic natural channels – an ongoing discussion at TRIECA



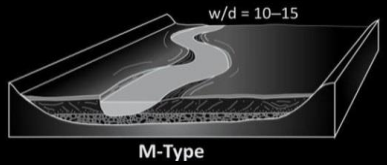

Paul Villard
"Respect for Alluvium"
Floodplain Communication

Brad Fairley
How to define *"failures"*
for NCD projects?


Jeff Muirhead
NCD expectations, medical
surgery analogy

2015 2016 2017 2018 2019

Roger Phillips
Alluvial channel types
in southern Ontario




Mark Hartley
Evolution of the riffle
and design methods

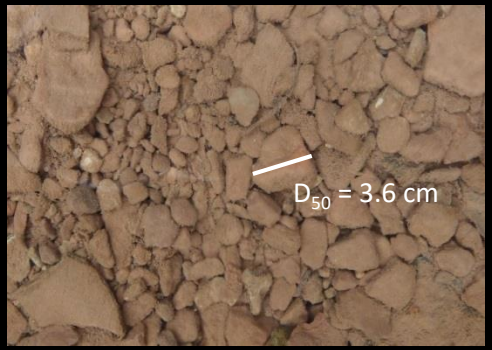

Alluvial
channel
design

**QUESTION:**

Are we missing opportunities
to implement alluvial channel designs?

# TAPLOW CREEK, OAKVILLE – semi-alluvial on shale bedrock

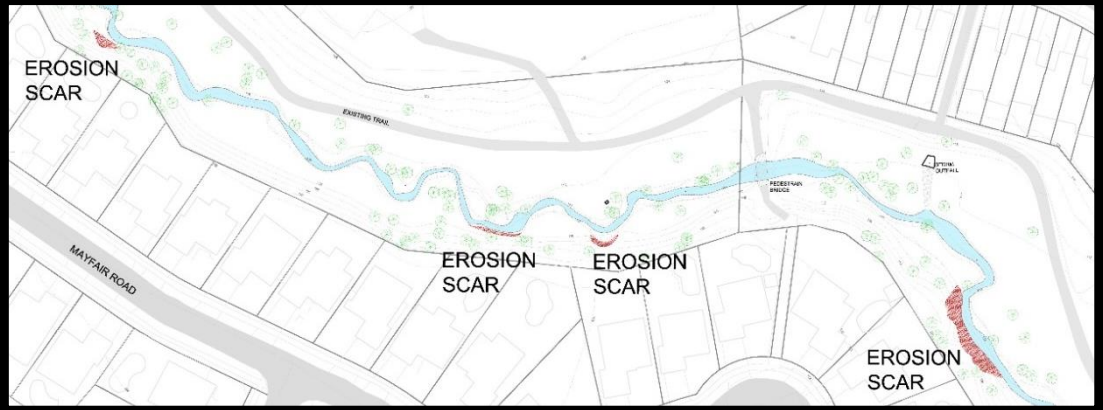
erosion & sediment dynamics




alluvial gravel bed

bedrock controlled

# TAPLOW CREEK – PROBLEM IDENTIFICATION

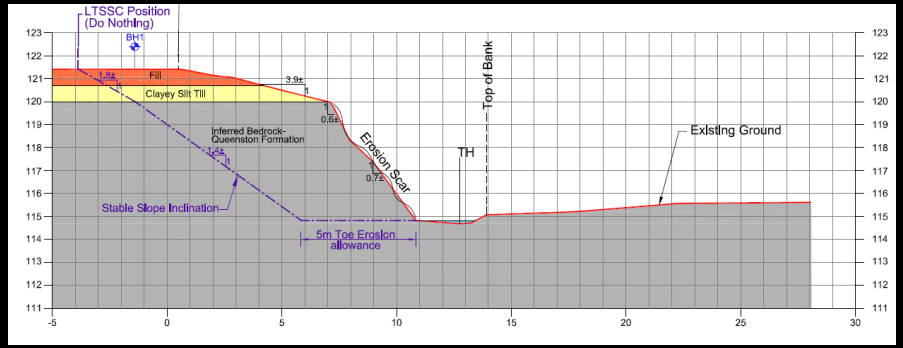



**Problem**

- Active erosion and slumping of valley wall
- Long-term stable slope crest indicated properties were at risk

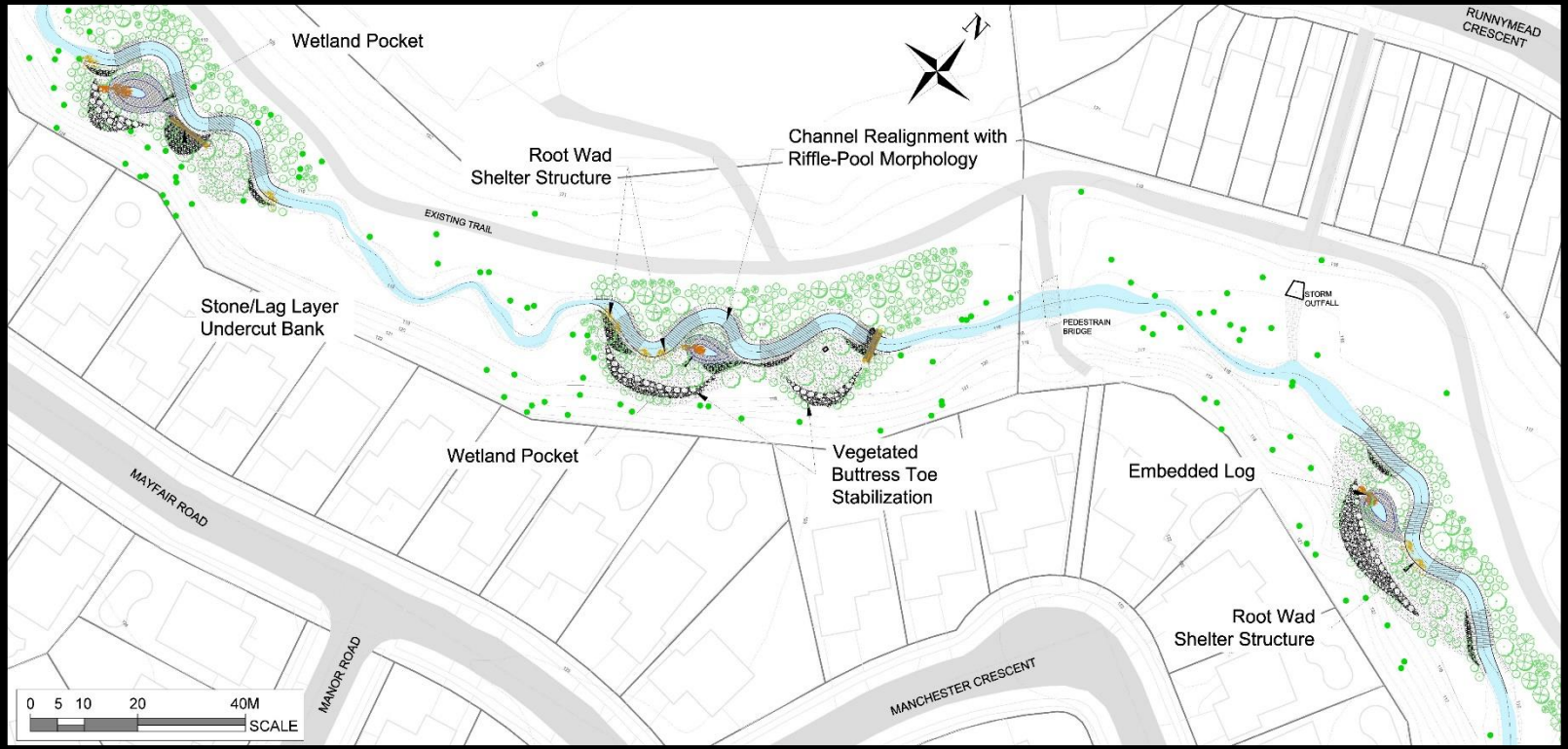
**Opportunity**

- Loss of many ash trees due to ash borer
- Invasive species management by Town

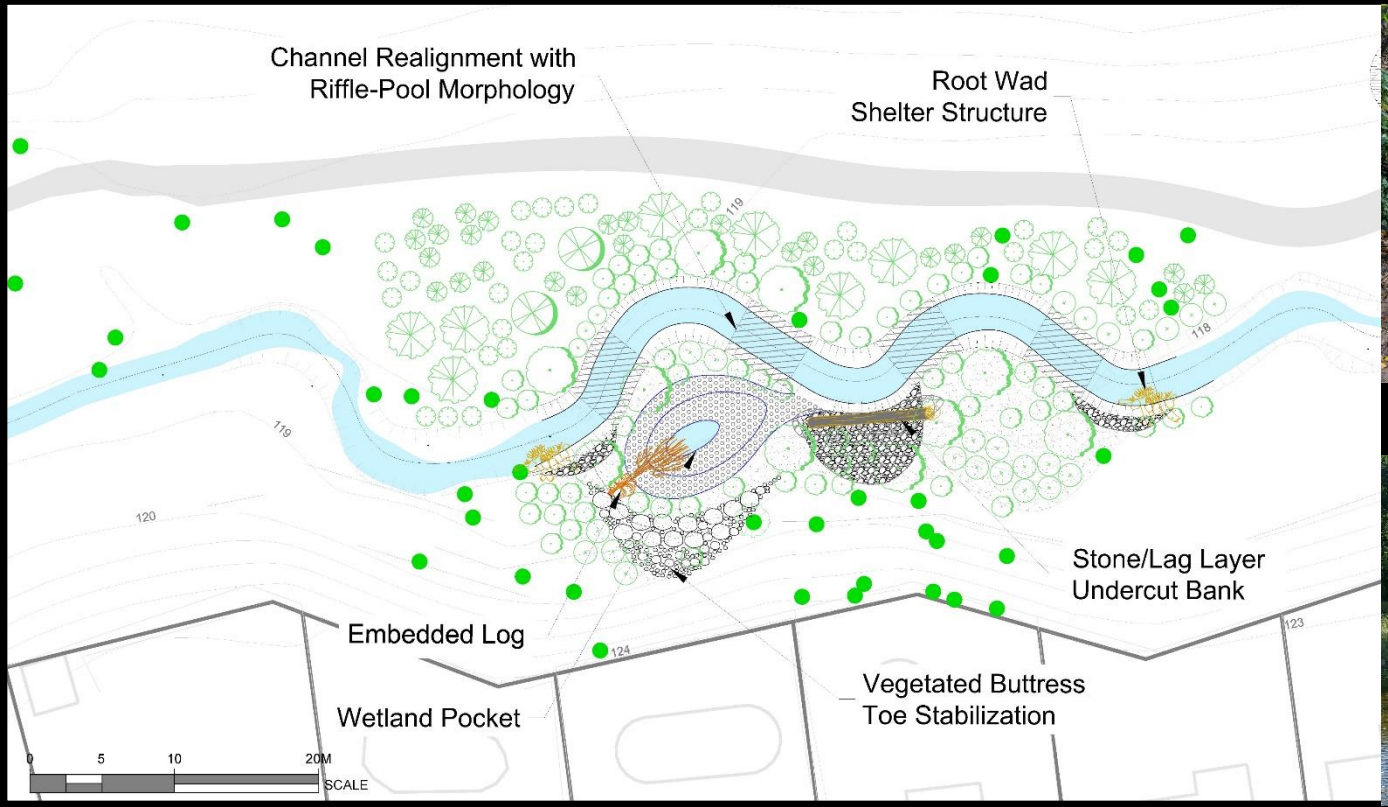


# TAPLOW CREEK – LOSS OF ASH TREES


# TAPLOW CREEK – DESIGN



# TAPLOW CREEK – DESIGN




Vegetated Buttress

# TAPLOW CREEK – CONSTRUCTION and FIELD FITTING

Flexibility in sizing of habitat features to make use of materials harvested on-site

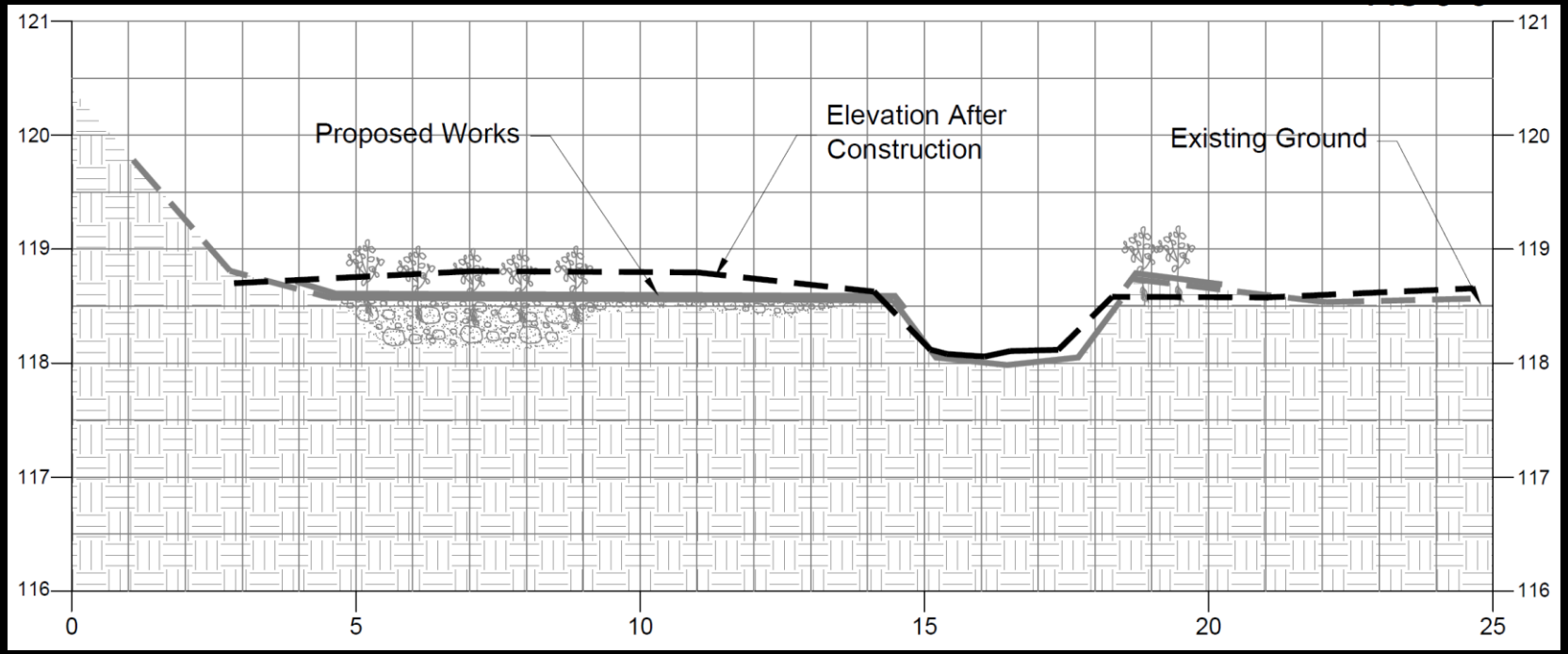
Adjustment of channel geometry to preserve trees

# TAPLOW CREEK – CHALLENGES

Variability in shale elevation

Shale riffle construction

# TAPLOW CREEK – CHALLENGES




Post-Construction As-Built Survey

# TAPLOW CREEK – SEDIMENT CONTROL

FLOW TRANSFER

**Initial Plan** (Phases 1 and 2):

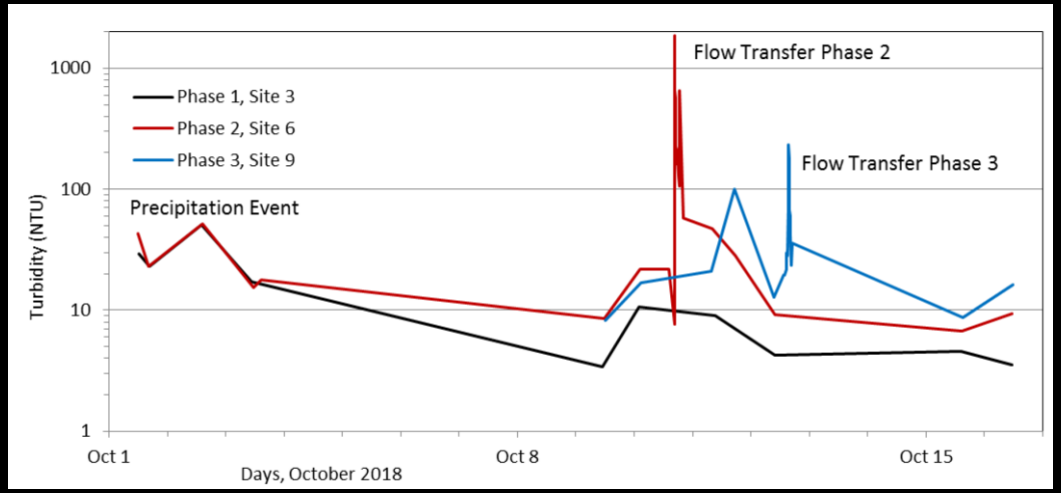
- Washing riffles and dewatering pools into filter bag
- Flow exceeded pump and filtration capacity
- Effectively an immediate flush and turbidity peak

**Adaptive Plan** (Phase 3):

- Cycling pump on and off to allow sediment to settle in pools
- Filtration through silt socks
- Reduction in peak turbidity of initial flush

Phase 3: Flow filtered through silt socks

# TAPLOW CREEK – SEDIMENT CONTROL




| Flow Transfer | Peak above 1000 NTU | Peak above 160 NTU | Peak above 50 NTU | Peak above 20 NTU |
|---|---|---|---|---|
| Phase 2 | 5 minutes* | 1 hour | 3.5 hours | ~ 24 hours |
| Phase 3 | none | 15 minutes | 1 hour | ~ 2 hours** |

* Peak value above 1000 NTU based on 2.5 g/L sample measurement and data calibration

** General trend, but fluctuations will continue to occur for an undetermined amount of time

Stream turbidity during flow transfer was reduced by:

- Cycling pumps to allow sediment to settle in pools
- Filtering flow through silt socks

# TAPLOW CREEK – SUCCESSES

Wetland Pockets, Embedded Logs, Plantings

Channel Bed (Post-Construction)

# TAPLOW CREEK – LESSONS LEARNED

- Shale riffle construction
- Accurate cut and fill balance
- Floodplain access
- Flexibility with field fitting
- Sediment control during flow transfer
- “Stream training” – don’t expect a static channel

Pre-construction: July 31, 2018

Construction: October 11, 2018

Post-construction: November 25, 2018

# Prepare the stream for nature, not nature for the stream

buried vegetated stone buttress

woody habitat features

exposed bedrock on bed

naturally forming point bars and cut banks

native gravel on riffles

# Are we missing opportunities to implement alluvial channel designs?

dynamic alluvial channels

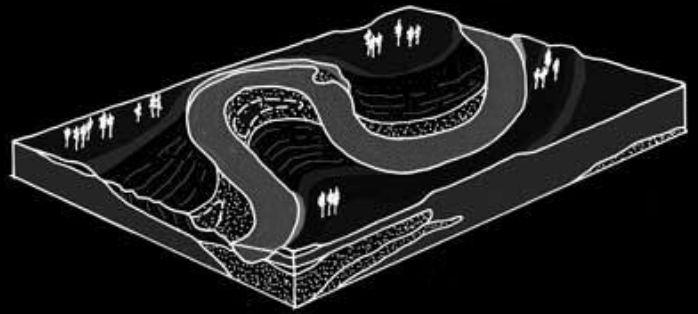
removing concrete channels

recreational parks and trails

headwater realignments

**Relevant questions to ask on your Natural Channel Design projects:**

- What are the long-term life cycle costs of harder NCD projects?
- Is there any space to allow for some channel movement?
- Can we find more space to reduce the risks of erosion hazards?
- What are the costs-benefits of allowing sediment dynamics?
- How to balance existing habitat with long-term impacts?

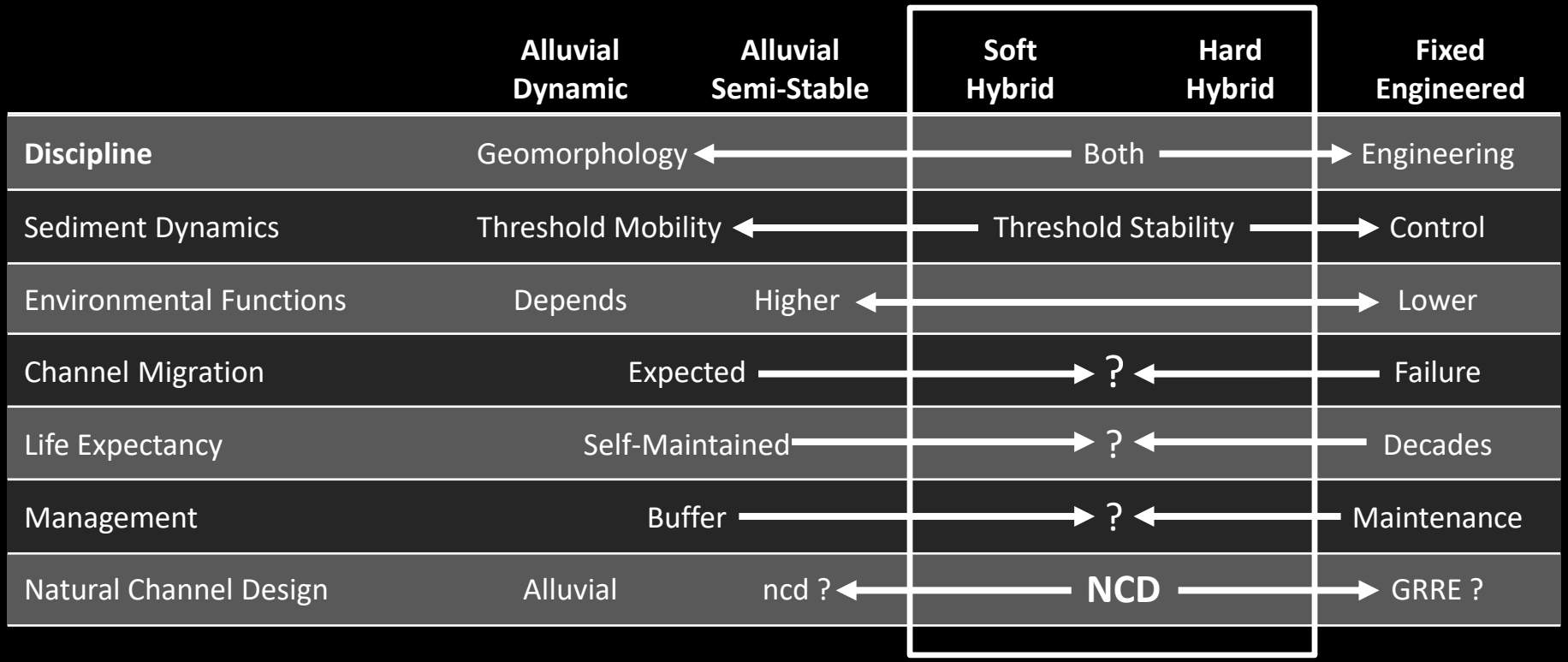


# Should we harden and control natural channels to protect…

…fence lines and landscaped yards?

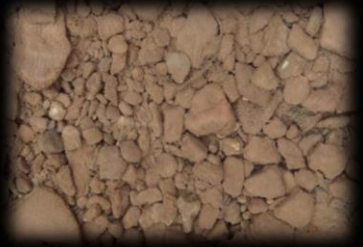
…recreational trails?

# The “hard” reality for Natural Channel Design…



# SHORT SUMMARY

- Alluvial channel design and Natural Channel Design – what's the difference?
- Challenges and mitigation strategies for constructing alluvial channels – Taplow Creek
- Prepare the stream for nature, not nature for the stream
- Are we missing opportunities to implement alluvial channel designs?
- The "hard" reality for Natural Channel Design… some unanswered questions



# LONGER SUMMARY

## Alluvial channel design and Natural Channel Design – what's the difference?

- **Alluvial channel design** – expectation of sediment dynamics (threshold sediment mobility at design discharge)
- **Natural Channel Design** – in practice, expectation of stable channel (threshold stability at design discharge)

## Challenges and mitigation strategies for constructing alluvial channels – Taplow Creek case study

- Variability of bedrock elevation and degree of weathering
- Importance of floodplain access and access variability
- Sediment management during flow transfer
- Flexibility with field fitting

## Prepare the stream for nature, not nature for the stream

- The value of "respect for alluvium" = sustainability and resilience – so push for ACD and softer NCD approaches where you can

## Are we missing opportunities to implement alluvial channel designs?

- Examples where "threshold stability" NCD or harder engineering is assumed best, but is it always?
- Ask questions about long-term costs-benefits of NCD and impacts of future maintenance and repairs to habitat

## The "hard" reality for Natural Channel Design… some unanswered questions

- ACD benefits of self-maintenance and potentially high environmental function – sediment dynamics can be a good thing
- Some "hard" questions about NCD largely unanswered, structural failure vs. long-term functions, life-cycle and maintenance costs

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